**assignment 3.2**

Questions 18, 23, 59 – 79 odd, 78, 80, 115

18) a and c have the same empirical formulas (same ratios)

23) The percents by mass are exactly the same no matter how large the sample. (Law of definite proportions.)

59) a. %C = 50.00 %H = 5.595 %O = 44.41
b. %C = 55.80 %H = 7.025 %O = 37.18
c. %C = 67.90 %H = 5.699 %N = 26.40

61) $N_2O$ NO $NO_2$ $N_2O_4$
*(highest %N)* *(lowest % N; tied)*

*63)*

$$4.34\% = \frac{58.93 \text{ g/mol Co}}{\text{mass of cyanocobalamin}} \times 100$$

*mass of cyanocobalamin = 1360 g/mol*

65) a. %C = 40.00 %H = 6.714 %O = 53.29
b. %C = 40.00 %H = 6.714 %O = 53.29
c. %C = 40.00 %H = 6.714 %O = 53.29
*(All have same empirical formula!)*

67) a. $N_2O_4 = 2(NO_2)$ b. $C_3H_6 = 3(CH_2)$
c. $P_4O_{10} = 2(P_2O_5)$ d. $C_6H_{12}O_6 = 6(CH_2O)$

69)

$$\frac{56.79 \text{ g C}}{} \left| \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right. = \frac{4.729 \text{ mol C}}{0.5910} = 8$$

$$\frac{6.56 \text{ g H}}{} \left| \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right. = \frac{6.508 \text{ mol H}}{0.5910} = 11$$

$$\frac{28.37 \text{ g O}}{} \left| \frac{1 \text{ mol O}}{16.00 \text{ g O}} \right. = \frac{1.773 \text{ mol O}}{0.5910} = 3$$

$$\frac{8.28 \text{ g N}}{} \left| \frac{1 \text{ mol N}}{14.01 \text{ g N}} \right. = \frac{0.5910 \text{ mol N}}{0.5910} = 1$$

***$C_8H_{11}O_3N$***

**assignment 3.2**

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71) Substance 1: $\frac{0.6018 \text{ g Hg}}{0.6498 \text{ g total}} \times 100 = 92.61\ \%\text{Hg}$ *7.39 %O*

$\frac{92.61 \text{ gHg}}{} \left| \frac{1 \text{ mol Hg}}{200.6 \text{g Hg}} \right. = \frac{0.4617 \text{ mol Hg}}{0.4619} = 1$

$\frac{7.39 \text{ gO}}{} \left| \frac{1 \text{ mol O}}{16.00 \text{g O}} \right. = \frac{0.4619 \text{ mol O}}{0.4619} = 1$

***HgO***

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Substance 2: $\frac{0.016 \text{ g O}}{0.4172 \text{ g total}} \times 100 = 3.84\ \%\text{O}$ *96.16 %Hg*

$\frac{96.16 \text{ gHg}}{} \left| \frac{1 \text{ mol Hg}}{200.6 \text{g Hg}} \right. = \frac{0.4794 \text{ mol Hg}}{0.240} = 2$

$\frac{3.84 \text{ gO}}{} \left| \frac{1 \text{ mol O}}{16.00 \text{g O}} \right. = \frac{0.240 \text{ mol O}}{0.240} = 1$

***$Hg_2O$***

73) $\frac{69.6 \text{ g S}}{} \left| \frac{1 \text{ mol S}}{32.07 \text{g S}} \right. = \frac{2.170 \text{ mol S}}{2.17} = 1$

$\frac{30.4 \text{ g N}}{} \left| \frac{1 \text{ mol N}}{14.01 \text{g N}} \right. = \frac{2.170 \text{ mol N}}{2.17} = 1$

***SN***

46.08 g/mol

$\frac{184 \text{ g/mol}}{46.08 \text{ g/mol}} = 4$ ***Molecular Formula = $S_4N_4$***

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75) $\frac{49.31 \text{ g C}}{} \left| \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right. = \frac{4.106 \text{ mol C}}{2.737} = 1.5$

$\frac{43.79 \text{ g O}}{} \left| \frac{1 \text{ mol O}}{16.00 \text{ g O}} \right. = \frac{2.737 \text{ mol O}}{2.737} = 1$

$\frac{6.90 \text{ g H}}{} \left| \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right. = \frac{6.845 \text{ mol H}}{2.737} = 2.5$

***$C_3O_2H_5$***

73.07 g/mol

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$\frac{146.1 \text{ g/mol}}{73.07 \text{ g/mol}} = 2$ ***Molecular Formula = $C_6O_4H_{10}$***

**assignment 3.2**

77) $\frac{2.641 \text{ g } CO_2}{} \left| \frac{12.01 \text{ g C}}{44.01 \text{ g } CO_2} \right. = 0.7207 \text{ g C}$

$\frac{1.442 \text{ g } H_2O}{} \left| \frac{2.016 \text{ g H}}{18.016 \text{ g } H_2O} \right. = 0.1613 \text{ g H}$

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$\frac{0.7207 \text{ g C}}{} \left| \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right. = \frac{0.06001 \text{ mol C}}{0.06001} = 1 \text{ } (x\ 3)$

$\frac{0.1613 \text{ g H}}{} \left| \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right. = \frac{0.1600 \text{ mol H}}{0.06001} = 2.667 \text{ } (x\ 3)$

***$C_3H_{10}$***

79) $\frac{42.8 \text{ g } H_2O}{} \left| \frac{2.016 \text{ g H}}{18.016 \text{ g } H_2O} \right. = 4.79 \text{ g H}$

*47.6 g cumene - 4.79 g H = 42.81 g C*

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$\frac{42.81 \text{ g C}}{} \left| \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right. = \frac{3.565 \text{ mol C}}{3.565} = 1 (x\ 3)$ ***$C_3H_4$***

$\frac{4.79 \text{ g H}}{} \left| \frac{1 \text{ mol H}}{1.008 \text{ g H}} \right. = \frac{4.752 \text{ mol H}}{3.565} = 1.33 \text{ } (x\ 3)$ 40.06 g/mol

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$\frac{120\text{ish g/mol}}{40.06 \text{ g/mol}} = 3$ ***Molecular Formula = $C_9H_{12}$***

**assignment 3.2**

78) $\frac{33.5\text{ g } CO_2}{} \left| \frac{12.01\text{ g C}}{44.01\text{ g } CO_2} \right. = 9.142\text{ g C}$

$\frac{41.1\text{ g } H_2O}{} \left| \frac{2.016\text{ g H}}{18.016\text{ g } H_2O} \right. = 4.599\text{ g H}$

*35.0 g total - 9.142 g C - 4.599 g H = 21.26 g N*

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$\frac{9.142\text{ g C}}{} \left| \frac{1\text{ mol C}}{12.01\text{ g C}} \right. = \frac{0.7612\text{ mol C}}{0.7612} = 1$

$\frac{4.599\text{ g H}}{} \left| \frac{1\text{ mol H}}{1.008\text{ g H}} \right. = \frac{4.563\text{ mol H}}{0.7612} = 6$ ***$CH_6N_2$***

$\frac{21.26\text{ g N}}{} \left| \frac{1\text{ mol N}}{14.01\text{ g N}} \right. = \frac{1.517\text{ mol N}}{0.7612} = 2$

80) $\frac{16.01\text{ g } CO_2}{} \left| \frac{12.01\text{ g C}}{44.01\text{ g } CO_2} \right. = 4.369\text{ g C}$

$\frac{4.37\text{ g } H_2O}{} \left| \frac{2.016\text{ g H}}{18.016\text{ g } H_2O} \right. = 0.489\text{ g H}$

*10.68 g total - 4.369 g C - 0.489 g H = 5.822 g O*

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$\frac{4.369\text{ g C}}{} \left| \frac{1\text{ mol C}}{12.01\text{ g C}} \right. = \frac{0.3637\text{ mol C}}{0.3637} = 1$

$\frac{0.489\text{ g H}}{} \left| \frac{1\text{ mol H}}{1.008\text{ g H}} \right. = \frac{0.4851\text{ mol H}}{0.3637} = 1.33$ ***$C_3H_4O_3$***

88.06 g/mol

$\frac{5.822\text{ g O}}{} \left| \frac{1\text{ mol O}}{16.00\text{ g O}} \right. = \frac{0.3639\text{ mol O}}{0.3637} = 1$

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$\frac{176.1\text{ g/mol}}{88.06\text{ g/mol}} = 2$ ***Molecular Formula = $C_6H_8O_6$***

**assignment 3.2**

115) $\frac{4.83\text{ g } CuSO_4}{159.62\text{ g } CuSO_4} \left| \frac{1\text{ mol } CuSO_4}{} \right. = \frac{0.003026\text{ mol } CuSO_4}{0.003026} = 1$

$\frac{0.272\text{ g } H_2O}{18.016\text{ g } H_2O} \left| \frac{1\text{ mol } H_2O}{} \right. = \frac{0.01510\text{ mol } H_20}{0.003026} = 5$

***$CuSO_4 \cdot 5H_2O$***

***Copper (II) Sulfate Pentahydrate***